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INSTITUTE OF AERONAUTICAL ENGINEERING

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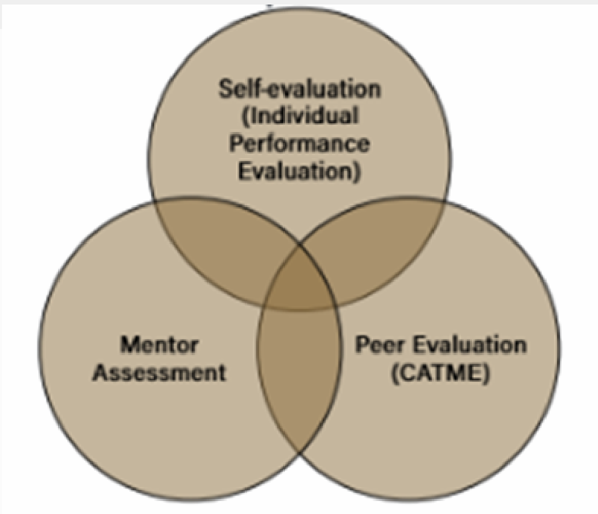
VIP Vertically Integrated Projects

INFORMATION PACKET

2024-2025



INSTITUTE OF AERONAUTICAL ENGINEERING

VERTICALLY INTEGRATED (VIP)- PROJRCTS

Information Packet

Academic Year: 2024-25

Appreciate IARE students who are showing interest in the Vertically Integrated (VIP) Project Program at the Institute of Aeronautical Engineering!

VIP Project team members work as part of a research group of students, research scholars, and faculty members to tackle novel research and design problems around a theme. The Vertically-Integrated Projects (VIP) Learning offers undergraduate engineering students the opportunity to collaborate with faculty mentors on extended research and design projects. These projects are aligned with active faculty research and industry-sponsored challenges, allowing students to engage in real-world interdisciplinary work. By participating in vertically-integrated teams, students from first-year to final year address complex design and research problems. In addition to hands on experience, students benefit from weekly lectures and professional development activities that cover essential topics such as design, research, documentation, technical writing, communication, leadership, ethics, project management, and intellectual property. The goals of VIP projects are

Goals of VIP

1. Provide undergraduate students an opportunity to work one-on-one with a faculty member and/or graduate student mentor.
2. Give undergraduate students exposure to faculty member's research area.
3. Provide undergraduate students an opportunity to experience team-work
   a. Collaboration b. Shared responsibility
   c. Mutual respect d. Teach each other
   e. Communications f. Leadership
4. Allow undergraduate students to stretch their imagination and express their creativity

The research theme of this VIP project also focuses on the challenges presented by the Sustainable Development Goals (SDGs).

IARE Sustainability Development Goals (SDGs) highlighted with Blue Colour Font	
SDG #1	End poverty in all its forms everywhere
SDG #2	End hunger, achieve food security and improved nutrition and promote sustainable agriculture
SDG #3	Ensure healthy lives and promote well-being for all at all ages
SDG #4	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
SDG #5	Achieve gender equality and empower all women and girls
SDG #6	Ensure availability and sustainable management of water and sanitation for all
SDG #7	Ensure access to affordable, reliable, sustainable and modern energy for all
SDG #8	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
SDG #9	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

SDG #10	Reduce inequality within and among countries
SDG #11	Make cities and human settlements inclusive, safe, resilient and sustainable
SDG #12	Ensure sustainable consumption and production patterns
SDG #13	Take urgent action to combat climate change and its impacts
SDG #14	Conserve and sustainably use the oceans, seas and marine resources for sustainable development
SDG #15	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
SDG #16	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
SDG #17	Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development

Learning Outcomes: An ability to

i. Apply engineering design to create a product (e.g., device, system, process, software, etc.) that meets the specified needs of engineering design experience with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
ii. Develop and conduct experimentation, analyse and interpret data, and use engineering judgment to draw conclusions related to the development of the product of the engineering design experience.
iii. Identify, formulate, and solve complex engineering problems arising from this engineering design experience by applying principles of engineering, science, and mathematics.
iv. Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives associated with the design experience
v. Communicate effectively with a range of audiences appropriate to the design experience in both a written report and oral presentation.
vi. Acquire and apply new knowledge as needed, using appropriate learning strategies to complete the engineering design experience associated with VIP project.
vii. Recognize ethical and professional responsibilities associated with engineering design experience and make informed judgments which must consider the impact of the product of the engineering design experience in global, economic, environmental, and societal contexts

The following research domains are recommended for HIPs-VIP Projects, and selected students should find the research gap and frame the problem statements from any one of the themes below.

1). Image Processing. (SDG #3, SDG #4)
2). Health Monitoring. (SDG #3, SDG #9, SDG #13)
3). System on Chip. (SDG #9)
4). UAV (Unmanned Aerial Vehicle and Drone Technology). (SDG #9)
5). Robotics. (SDG #4, SDG #9)
6). Artificial Intelligence. (SDG #4, SDG #9, SDG #13)

7). Developing secure IoT platform, building secure cloud infrastructure (SDG #3, SDG #4, SDG #9, SDG #13)
8). Alcohol detection and engine lock. (SDG #4, SDG #9, SDG #13)
9). Web development. (SDG #9, SDG #17)
10). Piracy (SDG #3, SDG #5, SDG #9, SDG #17)
11). Cyber Security (SDG #3, SDG #5, SDG #9, SDG #17)

In order to participate in VIP Projects, you must formally apply and be accepted by the project coordinator. To proceed, please mail to the project coordinator, Dr. VVSH Prasad (dean-cbcc@iare.ac.in), Dean of CBC (Competency Building and Consultancy).This will bring up all available open positions tagged as VIP projects. When submitting a project document and an updated résumé, include a statement regarding why you are interested in working with the team to which you are applying.

Please note that participation by the VIP project team requires registration for the accompanying research statement from any of the specified domains. More information will be provided to all selected VIP project applicants who have been offered a position.

If you have any questions about a particular team, please contact the team's faculty mentor(s).

We encourage you to contemplate this fascinating new opportunity. We look forward to receiving your application submission!

IMAGE PROCESSING

Dr S. China Venkateswarlu, Assistant Professor, Faculty Mentor Dept of ECE.

Dr B. Surekha Reddy, Assistant Professor, Faculty Mentor Dept of ECE

Goals

The primary goals of image processing in vertically integrated projects (VIPs) include the automation and enhancement of image-based decision-making systems. These projects aim to develop tools and systems that can analyse visual data efficiently, reduce human error, and provide accurate, real-time feedback in various environments. Whether improving the quality of an image, extracting useful information, or recognizing patterns and objects, the focus remains on enabling machines to "see" and interpret visual inputs much like the human eye, but with greater precision and speed.

Additionally, VIPs in image processing aim to provide long-term learning and development opportunities for undergraduate engineering students. They help cultivate multidisciplinary collaboration, foster research experience, and promote continuity in innovation. By working on real-world problems such as medical image diagnosis, environmental monitoring, or industrial automation, students are exposed to the broader impact of their work and contribute to sustainable, evolving research outcomes over multiple semesters.

METHODS & TECHNOLOGIES

Image processing projects typically follow a structured methodology that begins with image acquisition (capturing digital images via cameras or sensors), followed by preprocessing steps such as noise reduction, filtering, and normalization. Next comes segmentation (dividing an image into meaningful parts), feature extraction (identifying edges, shapes, or patterns), and classification (assigning labels to objects or areas within an image using algorithms). These steps may be repeated or adjusted based on the project's goals, such as object recognition or motion tracking.

In terms of technology, students use programming tools and frameworks like Python, OpenCV, and MATLAB for algorithm development and prototyping. For projects involving machine learning, TensorFlow, Keras, and PyTorch are commonly used, especially for training convolutional neural networks (CNNs) and other deep learning models. Hardware platforms may include Raspberry Pi, Arduino, and NVIDIA Jetson for embedded applications. Cloud services (e.g., AWS, Google Cloud) are also increasingly used for storage and processing of large datasets, enabling scalable solutions for complex image analysis tasks.

MAJORS & AREAS OF INTEREST

One major area of interest is medical imaging, where students can work on detecting tumors, enhancing MRI and CT scan images, or developing diagnostic support tools. These projects often require high precision and deep learning models capable of recognizing subtle patterns. Another key area is autonomous vehicles and robotics, where image processing is used for

navigation, obstacle avoidance, and environment recognition. These applications simulate human visual perception in real-time systems and contribute to advancements in mobility and automation.
Other VIP focus areas include remote sensing and environmental monitoring, where satellite or drone imagery is processed to track changes in land use, deforestation, or pollution. Smart surveillance systems use facial recognition and behavior analysis for security applications. Augmented reality (AR) and human-computer interaction (HCI) projects explore how visual inputs can drive user engagement and accessibility. Collectively, these areas allow students to work on impactful, interdisciplinary problems while contributing to long-term innovation in image-centric technologies.

Research Focus: Deep learning for medical image analysis, AI-powered predictive modelling, and natural language processing (NLP) for EHR data analysis.

Team Composition: Students from computer science, electrical engineering.

MENTOR CONTACT INFORMATION

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PARTNERS & SPONSORS

None

HEALTH MONITORING

Dr P. Purushottam Reddy, Professor & Head, Faculty Mentor Dept of IT

Goals

The goals of health monitoring in vertically integrated projects (VIPs) are centered on designing and developing systems that continuously or periodically track physiological parameters to promote early detection of health issues, improve disease management, and reduce the need for in-person clinical visits. These projects aim to empower individuals and healthcare providers with real-time data, enabling proactive medical decisions, improving patient outcomes, and lowering healthcare costs. Engineering undergraduates involved in VIPs contribute by innovating accessible, non-invasive, and user-friendly monitoring tools tailored to specific populations, such as the elderly or patients with chronic conditions.

Additionally, VIPs seek to foster long-term, interdisciplinary collaboration across different academic levels. These projects enable students to gain hands-on experience in system design, data analytics, and user-centered development while contributing to scalable, ongoing research. By participating in a team that spans multiple semesters and student cohorts, undergraduates help create sustainable solutions that can be refined and implemented in real-world healthcare scenarios, particularly for remote or under-resourced environments.

METHODS & TECHNOLOGIES

Health monitoring VIPs typically employ a structured methodology starting with the identification of a health metric (such as heart rate, blood pressure, glucose level, or body temperature) and the appropriate sensor to capture it. The process involves data acquisition through wearable or implantable sensors, preprocessing to remove noise, signal analysis for pattern recognition, and visualization through mobile or web-based platforms. These methodologies emphasize reliability, energy efficiency, data accuracy, and user comfort, often including alert systems for anomalies or emergencies.

Technologies used in such projects span both hardware and software. Common hardware platforms include Arduino, Raspberry Pi, and ESP32 microcontrollers integrated with sensors like ECG electrodes, temperature probes, pulse oximeters, and accelerometers. On the software side, programming languages like Python or C/C++ are used alongside data processing tools like MATLAB. Communication protocols such as Bluetooth, Wi-Fi, and GSM facilitate remote monitoring. Cloud platforms like Firebase or AWS are often used to store and process real-time health data, while app development tools (Flutter, Android Studio) help build interfaces for patients and caregivers

MAJORS & AREAS OF INTEREST

One significant area of interest for VIPs in health monitoring is chronic disease management, where students can work on systems to monitor diabetes (glucose tracking), hypertension (blood pressure monitors), or cardiac health (ECG analysis). These projects often focus on creating low-cost, portable, and easy-to-use devices that allow patients to self-monitor at home, reducing dependency on clinical visits and supporting early intervention. Elder care is

another important area, involving fall detection systems, medication reminders, and health tracking to support aging populations in living independently and safely.
Other promising areas include maternal and infant health, where projects may involve wearable monitors for fetal heart rates or neonatal vital signs, especially in rural or low-resource settings. Mental health monitoring is gaining interest, using physiological indicators like heart rate variability or skin conductance to infer stress and anxiety levels. Additionally, post-operative care and rehabilitation projects focus on tracking patient recovery, movement, or muscle engagement using biosensors. These diverse domains provide undergraduates with meaningful opportunities to contribute to health equity and digital health innovation through sustained, team-based research.

Research Focus: Deep learning for medical image analysis, AI-powered predictive modelling, and natural language processing (NLP) for EHR data analysis.

Team Composition: Students from computer science, electrical engineering

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PARTNERS & SPONSORS
None

SYSTEM ON CHIP

Dr. V R Seshagiri Rao, Assistant Professor, Faculty Mentor Dept of ECE
Dr. B Ravi Kumar, Assistant Professor, Faculty Mentor Dept of ECE

Goals

The primary goals of System on Chip (SoC) projects in vertically integrated settings are to design compact, efficient, and high-performance hardware systems that integrate all essential components—processor cores, memory, input/output interfaces, and communication modules—onto a single chip. These projects aim to reduce power consumption, minimize space requirements, and improve processing speed, making them ideal for embedded systems, mobile devices, and IoT applications. VIPs in this domain empower engineering students to contribute to the development of scalable, cost-effective hardware solutions for real-world applications.

Furthermore, SoC projects within VIPs aim to provide long-term experiential learning by engaging undergraduates in the end-to-end process of chip design and implementation. Students work collaboratively with peers, graduate mentors, and faculty over multiple semesters to build, test, and refine integrated systems. This hands-on experience bridges the gap between theoretical coursework and practical application, enhancing students' understanding of digital logic, VLSI design, embedded computing, and hardware/software co-design.

METHODS & TECHNOLOGIES

SoC development in VIPs typically begins with system specification and architectural design, followed by hardware description using languages like Verilog or VHDL. Simulation and verification are conducted using tools like ModelSim or Vivado to ensure functional correctness. Logic synthesis, place and route, and timing analysis are performed using EDA tools to create the physical design. If prototyping is needed, students implement the design on FPGA platforms before moving to ASIC development. Throughout, emphasis is placed on modularity, power optimization, and real-time processing capabilities.

The technologies involved include FPGA boards (e.g., Xilinx Zynq, Intel DE10), HDL simulators, synthesis tools, and integrated development environments (IDEs) like Vivado, Quartus, and ARM Keil. Students may also use SoC prototyping kits and development boards combining microprocessors and programmable logic. On the software side, C/C++ or Python may be used for firmware development. Projects often involve hardware/software co-design, where embedded Linux or RTOS platforms interface with custom hardware components, enabling students to understand the full computing stack from silicon to software.

MAJORS & AREAS OF INTEREST

One key area of interest is IoT and edge computing, where SoCs are used to process sensor data locally with minimal power usage. VIPs may focus on designing custom chips for smart home systems, wearable health monitors, or environmental sensing networks. These projects require tight integration of wireless communication, signal processing, and data analytics on a single chip. Another area is robotics and autonomous systems, where SoCs handle real-time control, vision processing, and decision-making in compact, power-efficient packages suitable for drones or mobile robots.

Other important domains include AI acceleration, where students develop or customize SoCs to run machine learning models at the edge, and cybersecurity, focusing on secure hardware design and cryptographic acceleration. Medical devices also benefit from SoC development, particularly for portable diagnostic tools and implantable systems requiring low-power, high-reliability chips. These areas offer rich opportunities for innovation, encouraging undergraduates to apply core engineering principles to design intelligent, efficient systems that drive advancements in technology and society.

Research Focus: Design and prototype low-power, application-specific System on Chip (SoC) solutions using FPGA and embedded systems for real-world applications like IoT, robotics, or healthcare.

Team Composition: Students from Electronics and Communication Engineering, Mechanical/Aerospace Engineering, Computer Science, and Electrical Engineering.

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PARTNERS & SPONSORS

None

UAV (UNMANNED AERIAL VEHICLE AND DRONE TECHNOLOGY)

Dr. A Ratan Babu, Assistant Professor, Faculty Mentor Dept of Aeronautical.

Goals

The primary goals of UAV and drone technology in VIPs are to design, develop, and deploy aerial systems that perform autonomous or semi-autonomous tasks for applications in surveillance, mapping, delivery, and environmental monitoring. These projects aim to enhance the intelligence, stability, and efficiency of UAVs while reducing energy consumption, cost, and human intervention. Students are expected to explore interdisciplinary challenges involving flight dynamics, control systems, sensor integration, and data communication.

VIPs also aim to immerse undergraduate students in long-term, research-driven development where they can contribute to real-world drone applications. These projects help foster collaboration among students from various academic levels and disciplines, encouraging innovation in both hardware (drone design, propulsion, payload) and software (navigation, object detection, mission planning). The overarching goal is to produce practical, scalable UAV solutions that can serve both civilian and industrial sectors.

METHODS & TECHNOLOGIES

UAV VIPs follow a development process that begins with system requirements and evolves through design, simulation, prototyping, and testing. Methodologies include CAD modeling for airframe design, aerodynamic analysis, selection of motors and propellers, control system design using PID or advanced algorithms, and sensor fusion for GPS, IMU, and vision-based navigation. Teams often iterate through testing cycles involving simulations (e.g., MATLAB, Gazebo) and real-world flight experiments.

Key technologies include microcontrollers (e.g., STM32, Arduino), flight control units (Pixhawk, Ardupilot), GPS modules, accelerometers, gyroscopes, barometers, and cameras for aerial vision. Communication systems like LoRa, Wi-Fi, and telemetry modules are used for remote control and data transmission. Students also employ software such as ROS (Robot Operating System), OpenCV for image processing, and Python or C++ for mission scripting. Advanced projects may integrate machine learning models for object detection, path optimization, or automated landing.

MAJORS & AREAS OF INTEREST

One major area of interest in UAV-based VIPs is environmental and agricultural monitoring, where drones are used for surveying crops, detecting soil moisture levels, or assessing damage from natural disasters. These projects involve integrating multispectral cameras and sensors to collect actionable data for sustainable land and resource management. Another prominent area is aerial surveillance and security, where UAVs are equipped with cameras and analytics software for patrolling campuses, industrial zones, or disaster-stricken areas.
Other active domains include last-mile delivery systems, where drones are developed to autonomously transport small payloads, and search and rescue missions, utilizing thermal

imaging and autonomous navigation in hard-to-reach locations. Precision mapping and 3D modeling is another important focus, where drones capture geospatial data for urban planning or archaeology. These areas not only engage students in advanced aerospace and software engineering challenges but also push them to create solutions that have real societal impact.

Research Focus: Design, develop, and test autonomous UAV systems for real-world applications such as aerial mapping, surveillance, and precision agriculture using advanced control, sensing, and navigation technologies.
Team Composition: Students from Electronics and Communication Engineering, Mechanical/Aerospace Engineering, Computer Science, and Electrical Engineering.

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PARTNERS & SPONSORS
None

ROBOTICS

Dr. G Himabindu, Assistant Professor, Faculty Mentor, Dept of ME

Goals

The primary goal of robotics in vertically integrated projects (VIPs) is to design, build, and program autonomous or semi-autonomous robotic systems that can perform specific tasks in dynamic environments. These systems may range from industrial robots used in manufacturing to mobile robots for search and rescue or healthcare applications. The focus is on integrating mechanical design, sensor systems, control algorithms, and user interfaces to create functional robots capable of operating with minimal human intervention. Through these projects, students will develop a deeper understanding of multi-disciplinary engineering and improve their problem-solving skills by tackling real-world challenges.

Additionally, VIPs in robotics seek to provide long-term, project-based experiences where undergraduates can contribute to both the theoretical and practical aspects of robot design and development. These projects foster team collaboration, encourage innovative solutions, and allow students to apply their knowledge in mechanical design, electronics, software engineering, and systems integration. By working on a sustained project, students gain hands-on experience in building complex robotic systems, from conceptualization through design, testing, and refinement, preparing them for future careers in robotics or related industries

METHODS & TECHNOLOGIES

Robotics projects in VIPs typically follow an iterative development methodology that includes system design, prototyping, testing, and optimization. The design phase involves CAD modeling, selection of components such as actuators, sensors, and controllers, and the creation of control algorithms. Once the system is built, testing focuses on evaluating the robot's performance and refining algorithms for navigation, task execution, and error handling. Students often use simulation tools to predict behavior before actual construction and may conduct several prototype iterations to meet project goals.

Technologies commonly used in robotics VIPs include microcontrollers (e.g., Arduino, Raspberry Pi, STM32) for controlling hardware, motor drivers for actuating movement, and various sensors such as LIDAR, cameras, ultrasonic sensors, and IMUs for environmental perception. Control algorithms are implemented using software such as ROS (Robot Operating System), Python, or C++, with AI/ML techniques for tasks like object recognition, path planning, or reinforcement learning. Additionally, communication protocols such as Bluetooth, Wi-Fi, or Zigbee are used for robot-to-human or robot-to-robot interaction, and platforms like OpenCV enable image processing. Students also use simulation environments like Gazebo or V-REP to test robots virtually.

MAJORS & AREAS OF INTEREST

One of the most popular areas for robotics VIPs is autonomous mobile robots, where students work on robots capable of navigating environments, avoiding obstacles, and performing tasks like delivery, cleaning, or surveying. Another area of growing interest is industrial automation, where students design robots for tasks like assembly, inspection, or packaging in manufacturing processes, using precision, speed, and repeatability. These robots often involve complex control systems and can be integrated with IoT devices for enhanced efficiency.

Other major areas include robotic healthcare systems, such as surgical robots, rehabilitation devices, or assistive robots for the elderly or disabled, which combine robotics with medical technologies. Swarm robotics, where multiple robots collaborate to achieve complex tasks, is another exciting area, with applications in disaster response or environmental monitoring. Additionally, robotic exoskeletons and human-robot interaction are emerging fields focusing on developing wearable devices that assist mobility or enhance human capabilities. These areas allow students to explore cutting-edge technologies and address challenges with societal impact.

Research Focus: Design and develop autonomous robotic systems, integrating mechanical, electrical, and software components to perform specific tasks in dynamic environments such as navigation, object manipulation, and human-robot interaction.
Branch Composition: Students from Mechanical Engineering (for design and control systems), Electronics and Communication Engineering (for sensors and actuators), Computer Science (for software development and AI), and Electrical Engineering (for power systems and circuit design).

MENTOR CONTACT INFORMATION

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PARTNERS & SPONSORS

None

ARTIFICIAL INTELLIGENCE

Dr. M Nagaraju, Assistant Professor, Faculty Mentor, Dept of AIML

Goals

The primary goal of AI in vertically integrated projects (VIPs) is to design and implement intelligent systems capable of solving complex problems through data analysis, pattern recognition, and decision-making algorithms. AI projects aim to develop systems that can learn from data, make predictions, automate tasks, and adapt to new information. Engineering undergraduates in these VIPs will explore AI techniques such as machine learning (ML), deep learning (DL), natural language processing (NLP), and computer vision to create systems that can perform tasks autonomously and with a high degree of accuracy, making them suitable for applications in healthcare, robotics, finance, and more.

In addition to providing hands-on experience with AI algorithms and tools, these projects encourage interdisciplinary collaboration. Students will work across domains like data science, software development, and hardware integration, focusing on understanding the ethical and practical implications of deploying AI systems in real-world applications. By working through the development cycle—from problem identification and data collection to model building and deployment—students gain valuable skills in AI design, optimization, and deployment that are highly relevant to industry and research opportunities.

METHODS & TECHNOLOGIES

AI VIPs typically follow a structured methodology that begins with defining the problem, followed by data collection, preprocessing, and feature extraction. The next steps involve selecting appropriate AI models or algorithms, training models using labeled data, and evaluating their performance using metrics like accuracy, precision, recall, and F1 score. The process includes iterative testing and optimization of models to ensure they generalize well to unseen data. Projects often involve integrating AI systems with real-time applications, where students need to consider factors such as data latency, model complexity, and resource constraints.

The technologies used in AI projects include machine learning frameworks like TensorFlow, Keras, and PyTorch for model development, along with scikit-learn for traditional machine learning. For deep learning applications, tools like OpenCV (for computer vision) and NLTK or spaCy (for NLP) are commonly used. Cloud platforms (e.g., Google Cloud, AWS, Microsoft Azure) are often utilized for data storage, model training, and deployment. Programming languages such as Python and R are the core tools for AI algorithm development, while tools like Jupyter Notebooks and Google Colab enable interactive development and experimentation.

MAJORS & AREAS OF INTEREST

A significant area of interest in AI VIPs is machine learning and predictive analytics, where students develop models to predict outcomes based on historical data. Applications in healthcare, such as disease diagnosis or personalized treatment plans, and finance, like fraud detection or stock market prediction, are key focus areas. Another growing area is computer vision, where AI is used for object detection, image classification, and autonomous

navigation, with applications in industries such as automotive (self-driving cars) and manufacturing (quality control).
Natural Language Processing (NLP) is also a major area, where AI models are used to understand and generate human language, powering applications like chatbots, sentiment analysis, and machine translation. Reinforcement learning (RL) is gaining traction in robotics and gaming, where AI agents learn optimal behavior through trial and error. Finally, **ethical** AI and AI for social good are emerging areas that involve building AI systems with fairness, transparency, and accountability, with applications in education, environmental sustainability, and public policy.

Research Focus: Design and develop intelligent systems using AI techniques like machine learning, deep learning, and natural language processing to solve real-world problems in fields such as healthcare, robotics, and data analytics.

Branch Composition: Students from Computer Science (for AI algorithms and programming), Electronics and Communication Engineering (for sensor integration and embedded systems), and Electrical Engineering (for hardware optimization and AI model deployment).

MENTOR CONTACT INFORMATION

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PARTNERS & SPONSORS

None

DEVELOPING SECURE IOT PLATFORM, BUILDING SECURE CLOUD INFRASTRUCTURE

Meghamala Y, Assistant Professor, Faculty Mentor, Dept of ECE

Goals

The primary goal of a VIP focused on developing secure IoT platforms is to design and implement a scalable, connected ecosystem of devices that communicate efficiently while maintaining data privacy, device authentication, and network security. The project aims to build a robust IoT architecture that ensures secure data transmission, prevents unauthorized access, and resists cyber threats such as man-in-the-middle attacks, spoofing, and device tampering. Students will gain hands-on experience in integrating sensors, embedded systems, and secure communication protocols for use in domains such as smart homes, healthcare, or industrial monitoring.

The project also seeks to expose students to the full IoT development lifecycle, from edge device programming to cloud data processing and visualization. An emphasis is placed on **end-to-end security**, involving hardware trust anchors, secure firmware updates, and encrypted data channels. By collaborating across levels and disciplines, students can explore advanced topics like lightweight cryptography, secure boot mechanisms, and intrusion detection systems tailored to resource-constrained IoT devices.

METHODS & TECHNOLOGIES

Students will adopt a modular development methodology—starting with device provisioning, followed by secure communication setup, cloud integration, and real-time monitoring. Threat modeling, risk analysis, and security-by-design principles guide the development process. Penetration testing, firmware validation, and anomaly detection techniques will be applied iteratively to improve platform resilience.

Key technologies include microcontrollers (ESP32, STM32), IoT operating systems (FreeRTOS, RIOT), and communication protocols (MQTT, CoAP, HTTPS). Security features will use TLS/SSL, public key infrastructure (PKI), and blockchain-based identity verification. Students will use tools like Wireshark, Node-RED, and AWS IoT Core or Azure IoT Hub for cloud integration and real-time monitoring. Languages such as C/C++, Python, and JavaScript will be used for device, edge, and cloud-layer development.

MAJORS & AREAS OF INTEREST

Key areas include data encryption at rest and in transit, secure API gateways, container and serverless security, and compliance automation. Projects may focus on developing secure CI/CD pipelines, multi-tenant access control models, or resilient backup and disaster recovery systems.

Students can also explore cloud-native threat detection, secure microservices, and AI-enhanced security analytics. As edge-cloud integration becomes more prevalent, VIPs can expand to topics like hybrid cloud security, fog computing, and distributed identity management for decentralized applications.

Research Focus: Design and implement secure, scalable IoT platforms and cloud infrastructures with strong data protection, authentication, and threat mitigation mechanisms.

Branch Composition: Students from Computer Science (for security protocols and cloud services), Electronics and Communication Engineering (for IoT hardware and communication), and Information Technology or Electrical Engineering (for system integration and network security).

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PARTNERS & SPONSORS
None

ALCOHOL DETECTION AND ENGINE LOCK

Dr. C Labesh, Assistant Professor, Faculty Mentor, Dept of ME

Goals

The primary goal of an Alcohol Detection and Engine Lock VIP is to design a smart vehicle safety system that detects whether a driver is under the influence of alcohol and prevents the engine from starting if intoxication is detected. This system aims to reduce road accidents caused by drunk driving by enforcing an automated, non-intrusive safety check before ignition. The project emphasizes real-time alcohol detection using sensor technology and ensuring fast, reliable, and tamper-proof responses to prevent unsafe driving conditions.

The secondary goal is to integrate this solution with other vehicle systems for broader safety and reporting capabilities, such as alerting emergency contacts or law enforcement in case of repeated violations. The VIP also encourages students to understand the legal, ethical, and social aspects of deploying such systems in consumer vehicles, with a focus on ensuring user privacy and minimizing false positives.

METHODS & TECHNOLOGIES

The project development typically starts with integrating an alcohol sensor (such as the MQ-3 or MQ-135) to detect the presence and concentration of ethanol in the driver's breath. The system uses a microcontroller (e.g., Arduino or Raspberry Pi) to process sensor data and determine whether the alcohol level exceeds legal limits. If the threshold is crossed, the microcontroller triggers a relay mechanism to disable the ignition system. The methodology involves sensor calibration, real-time signal processing, and system validation under varying conditions.

Technologies used in this VIP include gas sensors (MQ series), microcontrollers, vehicle relays, and optional components like GSM modules for alert systems or biometric verification for user identification. Programming is typically done in C/C++ or Python, and simulation tools like Proteus or MATLAB/Simulink can be used to model the system. Advanced versions may include data logging via IoT platforms (such as Blynk or ThingSpeak), GPS integration, and mobile app connectivity for alert notifications.

MAJORS & AREAS OF INTEREST

A major area of focus in this project is road safety and accident prevention, using embedded electronics to create intelligent vehicle systems. This VIP can be extended to study human-machine interaction and how automation in vehicles can reduce human error. The system's design can evolve to include driver fatigue monitoring, combining alcohol detection with drowsiness detection or facial recognition for broader safety coverage.

Other areas include automotive cybersecurity (to prevent system tampering), vehicle telematics (for incident reporting and fleet management), and regulatory compliance engineering (ensuring the system meets transport authority standards). The VIP can also expand into connected car technologies, where alcohol detection data integrates with smart city infrastructure for real-time monitoring and enforcement.

Research Focus: Develop a smart vehicle system that detects driver alcohol levels in real time and prevents engine ignition to enhance road safety.

Branch Composition: Students from Electronics and Communication Engineering (for sensors and circuit design), Computer Science (for control logic and programming), and Automobile or Electrical Engineering (for engine integration and system deployment).

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PARTNERS & SPONSORS
None

WEB DEVELOPMENT

Ms. CSL Vijaya Durga, Assistant Professor, Faculty Mentor, Dept of IT

Goals

The primary goal of a Web Development VIP is to design and deploy interactive, responsive, and scalable web applications that address real-world problems or improve digital services in various sectors such as education, healthcare, e-commerce, or smart governance. These projects aim to provide students with full-stack development experience—front-end design, back-end logic, database management, and deployment—while focusing on usability, accessibility, performance, and security.

Students in these projects also aim to learn and apply best practices in UI/UX design, SEO optimization, data privacy compliance, and web accessibility standards. Whether creating social platforms, dashboards, service portals, or custom content management systems, the objective is to deliver robust, user-centered solutions that demonstrate both technical proficiency and problem-solving ability through iterative development and testing.

METHODS & TECHNOLOGIES

Web development VIPs generally follow agile or iterative development methodologies involving planning, design, development, testing, and deployment phases. The team often works in sprints, using tools like version control (Git), project boards (Trello, Jira), and continuous integration pipelines to manage progress. Emphasis is placed on modularity, scalability, and responsive design across devices.

Technologies used include HTML5, CSS3, JavaScript, and frameworks like React.js, Angular, or Vue.js for front-end development. For the back end, Node.js, Express, Django, or Spring Boot are common, paired with databases like MySQL, MongoDB, or PostgreSQL. APIs (REST or GraphQL), authentication systems, and cloud platforms (AWS, Firebase, or Heroku) are used for full-stack integration. Version control is managed through GitHub or GitLab, and testing tools like Jest or Selenium ensure code reliability.

MAJORS & AREAS OF INTEREST

Key areas of interest in web development VIPs include e-commerce platforms, student management systems, healthcare portals, and smart city dashboards. Teams may focus on building systems that manage user data securely, provide analytics, or automate common workflows like booking, payments, and form submissions. Another area of interest is progressive web apps (PWAs) that work offline and provide near-native experiences on mobile devices.

Other emerging areas include real-time web applications (like chat systems and live dashboards), AI-integrated web apps (e.g., recommendation systems), and web accessibility to support inclusive design. Security-focused projects might include data encryption, role-based access control, and compliance with privacy laws such as GDPR or HIPAA. The broad scope of web development allows cross-disciplinary collaboration with healthcare, education, business, and IoT-focused teams.

Research Focus: Design and develop responsive, secure, and scalable web applications addressing real-world needs in sectors like education, healthcare, and e-commerce.
Branch Composition: Students from Computer Science, Information Technology, and Electronics and Communication Engineering for full-stack development, UI/UX design, and system integration.

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PARTNERS & SPONSORS
None

PIRACY

Dr. Obul Konda Reddy, Assistant Professor, Faculty Mentor, Dept of Cyber Security

Goals

The goal of a VIP focused on piracy prevention is to design intelligent systems that detect, prevent, and deter digital content piracy across platforms such as software, movies, music, e-books, and streaming media. Students aim to explore legal, ethical, and technical frameworks to secure digital rights and protect intellectual property by developing anti-piracy tools and mechanisms.

The project also emphasizes raising awareness about the impact of piracy and integrating secure digital distribution models. A strong focus is placed on digital rights management (DRM), watermarking, encryption, and blockchain-based verification to track and authenticate content ownership. The ultimate goal is to make piracy detection efficient, scalable, and adaptable across industries.

METHODS & TECHNOLOGIES

The methodology involves studying current piracy methods (e.g., torrenting, screen recording, unauthorized distribution) and developing solutions through forensic watermarking, hash-based detection, or AI-driven content scanning. Students will perform threat modeling and use signature-based and behavioral analysis techniques to flag pirated content or unauthorized use.

Key technologies include blockchain (for content authentication), machine learning (for pattern recognition and piracy detection), DRM protocols, invisible watermarking, and cloud-based monitoring systems. Development tools may involve Python, TensorFlow, OpenCV, FFmpeg, and cryptographic libraries. Integration with content delivery networks (CDNs) and media platforms is also explored for real-time protection.

MAJORS & AREAS OF INTEREST

Major areas include digital content protection (videos, music, books), software license verification, and intellectual property tracking. Students can work on systems that detect pirated media on the internet, validate software authenticity, or build tools that automatically take down unauthorized content from platforms.

Other focus areas may include secure media streaming, dynamic watermarking, peer-to-peer piracy monitoring, and legal compliance automation. Combining AI with cybersecurity, the VIP can also explore innovations like piracy fingerprinting systems, reverse image/audio search engines, and user behavior analytics for piracy risk scoring.

Research Focus: Develop intelligent systems for detecting, preventing, and tracking digital piracy using DRM, watermarking, AI, and blockchain technologies.

Branch Composition: The team should include students from Computer Science, Information Technology, and Electronics and Communication Engineering for expertise in cybersecurity, media processing, and system development.

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PARTNERS & SPONSORS

None

CYBER SECURITY

Dr. Obul Konda Reddy, Assistant Professor, Faculty Mentor, Dept of Cyber Security

Goals

The primary goal of a cybersecurity-focused VIP is to develop systems and frameworks that protect data, devices, and networks from unauthorized access, attacks, and breaches. The project aims to equip students with skills in ethical hacking, secure coding, vulnerability assessment, and cyber threat intelligence while addressing real-world security challenges across sectors like finance, healthcare, defense, and IoT.

Students also work to understand the principles of confidentiality, integrity, and availability (CIA Triad), and build solutions that detect, respond to, and mitigate security threats. This includes implementing access controls, intrusion detection systems, encryption schemes, and security audits. The VIP also encourages research into emerging cybersecurity concerns like zero-day attacks, phishing, ransomware, and social engineering.

METHODS & TECHNOLOGIES

Students follow a security-by-design methodology, involving threat modeling, risk assessment, vulnerability scanning, secure system architecture design, and penetration testing. Agile development and DevSecOps practices are often used to embed security throughout the development lifecycle. Red team-blue team simulations may also be conducted to test defenses.

Technologies and tools used include Kali Linux, Wireshark, Metasploit, Snort, Nmap, and Burp Suite for testing and exploitation. Programming in Python, C/C++, and JavaScript supports the creation of secure applications and automation scripts. Cryptographic libraries (OpenSSL), blockchain, and cloud security platforms (AWS Security Hub, Azure Defender) are also leveraged. Students may integrate machine learning models for anomaly detection and threat prediction in advanced applications.

MAJORS & AREAS OF INTEREST

VIPs can focus on areas such as network security, application security, cloud security, IoT and embedded device protection, and ethical hacking. Projects might involve designing firewalls, secure authentication systems, or phishing detection tools. Building secure communication protocols and mobile app protection frameworks are also popular focus areas. Emerging interest areas include cyber forensics, AI for threat detection, secure blockchain applications, ransomware defense mechanisms, and security awareness platforms. Regulatory and compliance-related studies (GDPR, HIPAA) also present opportunities to merge legal knowledge with technical innovation in cybersecurity solutions.

Research Focus: Develop proactive and intelligent cybersecurity systems for threat detection, secure communication, and data protection across digital infra structures.

Branch Composition: Students from Computer Science, Information Technology, and Electronics and Communication Engineering for expertise in network security, cryptography, and secure system design.

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None